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BOOK REVIEW

Chemistry of Microporous Crystals. Edited BY T. INUI, S. NAMBA, AND T. TATSUMI. **Studies in Surface Science and Catalysis,** Vol. 60. Kodansha/Elsevier, Tokyo/Amsterdam/New York, 1991. 390 pp. $168.50.

The book covers several important topics on microporous crystals including synthesis, structure, modification, diffusion, and catalysis. Under microporous crystals, the authors describe mainly zeolites, metal-substituted zeolites, and modified clays. While the authors represent a wide range of research from many countries from academe and to lesser extent from industry, Japan represents the largest contribution in the book. In contrast to previous meetings on zeolites, this volume concentrates on new materials and new catalytic phenomena with meager coverage on major current industrial applications.

The *synthesis* section deals more with characterization than with synthesis. For example, xenon NMR technique is applied to characterize the changes in the gel during the crystallization of SAPO-37. The radial distribution function is used elsewhere to describe the structure of amorphous silica–alumina gel. It is suggested that the hydrogel precursor comprises mainly four-member chains, proposed to be precursors of sodalite units. In the synthesis of ferrisilicate zeolites a comprehensive characterization is given on the iron using magnetic and other techniques. Dealing with synthesis itself, a new synthesis procedure is described for the synthesis of VPI-5 and on its transition to the AlPO-8 phase. The successful synthesis of three new families, GaPO's, AlAsO's, and GaAsO's, with microporous frameworks or layered structures also described, revealing the diversity of this compositional system which favors gallium for molecular sieve crystal formation. Several discussions deal with the synthesis and pilloring of clays using various chemical agents and treatments.

In the *structure* section, a very interesting paper on crystal chemistry concludes that in natural zeolites the perfect order, as well as the perfect disorder, are practically absent for the aluminum content. It also finds that Loewenstein's rule is valid in all zeolites studied. The state of the art is reviewed on developments in X-ray and neutron diffraction methods for zeolites using synchrotron X radiation. The use of NMR techniques is described to follow the position of zeolite cations and that of framework aluminum in zeolites. In the latter case a relationship is drawn between aluminum siting and acidity in Zeolite L.

In the *modification* section a discussion is given on the introduction of guest atoms into MFI structure by application of metal chloride vapor at elevated temperatures.

The *diffusion* section provides a formal description of diffusion and self-diffusion in zeolites and an interesting IR method for investigating diffusion and counterdiffusion of benzene and ethylbenzene in ZSM-5.

Catalysis is the longest section dealing with diverse topics. The first part gives several valuable reviews. A thorough review is given on partial oxidation catalysis using both molecular oxygen and peroxidic reagents with zeolites and with metal-exchanged or metal-substituted crystals. The discussion points out possibilities for selectivity based on molecular sieve action. Another excellent discussion details the successful application of titanium-substituted silicalite as catalyst in the selective oxidation of organic molecules including olefins and aromatics using dilute hydrogen peroxide as oxidant. Here, commerical production of catechol and hydroquinone using the titanium silicalite is also reported, together with a discussion of the scope of the reaction chemistry. Another paper summarizes the complex, acid-catalyzed reaction chemistry over zeolite catalysts. It is proposed that protonation of paraffins via pentacoordinated carbonium ion and the classical bimolecular carbenium chain reactions are both applicable depending upon reaction conditions. The shape-selective reactions of alkylnaphthalenes is described in a paper using several medium-pore zeolites, pointing to the importance of this pore size regarding both product selectivity and suppression of coke formation. A discussion deals with the role of hydrogenation and acid functions in the high-temperature, catalytic aromatization of light paraffins. The catalytic decomposition of nitrogen monoxide is evaluated over copper-exchanged zeolites, and IR, ESR evidence is presented for a proposed reaction mechanism of this environmentally important reaction. An interesting, ship in bottle synthesis of sterically crowded Fe–phthalocyanines in NaY zeolite is described, together with catalytic activity for alkanes. Significantly, the sterically crowded complex exhibited higher activities and selectivities toward terminal hydroxylation of *n*-hexane and *trans*-epoxidation of stilbens. These experiments increase the scope of shape selectivity and molecular sieve action, with new opportunities for catalysis to produce heteroorganic compounds at high selectivity.

In addition to catalysis with zeolites, this section describes several catalysis studies with modified clays.

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